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Department of State **EXCISE INCOMING TELEGRAM**

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CONFIDENTIAL SECTION 01 OF 22 NEW DELHI 22414

VIENNA FOR UNVIE, DEPT PASS DOE

E.O. 12356: DECL: OADR
TAGS: ENRG, TRGY, NRP, IN
SUBJ: INDIA'S NUCLEAR ENERGY PROGRAM

REF: (A) NEW DELHI 19918 (NOTAL); (B) NEW DELHI 17968
- (NOTAL); (C) NEW DELHI 11762 (NOTAL);
- (D) NEW DELHI 10875 (NOTAL); (E) NEW DELHI 10249
- (NOTAL); (F) NEW DELHI 10511 (NOTAL);
- (G) NEW DELHI 9061 (NOTAL); (H) NEW DELHI 6776
- (NOTAL); (I) 35 NEW DELHI 21704 (NOTAL).

1. CONFIDENTIAL ENTIRE TEXT.

2. SUMMARY. INDIA TODAY CONSUMES OVER 150 BILLION KILOWATT HOURS (KWH) OF ELECTRICITY OF WHICH NUCLEAR POWER PROVIDED ABOUT THREE PERCENT (ALMOST FIVE BILLION KWH). BY THE YEAR 2000, PROJECTIONS BY THE DEPARTMENT OF ATOMIC ENERGY (DAE) SEE CONSUMPTION ALMOST TRIPILING, TO 400 BILLION KWH, AND NUCLEAR POWER PLANTS PROVIDING TEN PERCENT OF THAT POWER, 40 BILLION KWH.

3. INDIA'S 15 YEAR NUCLEAR POWER PROGRAM CALLS FOR INSTALLED NUCLEAR POWER GENERATION CAPACITY TO INCREASE FROM TODAY'S 1,230 MW IN SIX REACTORS TO 10,000 MW IN 38 REACTORS BY THE YEAR 2000. (THIS IS THE SAME GOAL THAT CHINA RECENTLY ADOPTED.) DAE OFFICIALS ARE CONFIDENT OF ACHIEVING THIS GOAL PROVIDING THEY GET THE NECESSARY FUNDS. (THE GOI IS ENCOURAGING DAE TO USE NONGOVERNMENTAL FUNDS TO HELP REACH THE GOAL.) PROBLEMS OF HEAVY WATER PRODUCTION, CONSTRUCTION DELAYS, LOW QUALITY MANUFACTURED MATERIAL, LOW URANIUM PRODUCTION (ONLY ONE OPERATIONAL MINE NOW BUT FOUR PLANNED BY THE END OF THE DECADE), AND SAFETY WILL ALL BE SOLVED IN TIME, THEY BELIEVE. INDIA HAS BUILT AN IMPRESSIVE ESTABLISHMENT OF BASIC AND APPLIED RESEARCH, PROGRAM DESIGN AND DEVELOPMENT, AND MANAGEMENT ORGANIZATIONS. INDIA HAS THE LARGEST BODY OF NUCLEAR SCIENTISTS AND ENGINEERS IN THE DEVELOPING WORLD, OVER 21,500.

4. THE DAE 86-87 BUDGET HAS INCREASED FIFTY PERCENT OVER LAST YEAR TO OVER 750 MILLION DOLLARS. ESTIMATED DAE REVENUE FROM NUCLEAR POWER ARE 20 MILLION DOLLARS. ADDITIONAL REVENUE COULD BE RAISED BY INCREASING FERTH CHARGES, WHICH ARE 10 TO 15 PERCENT OF THE COST OF FERTH.

5. INDIA MADE IMPORTANT SCIENTIFIC STRIDES BUT ALSO SUFFERED MAJOR OPERATIONAL SETBACKS IN ITS NUCLEAR PROGRAM IN 1985-86. ON THE POSITIVE SIDE, THE FAST BREEDER TEST REACTOR (FBTR), THE SECOND POWER STATION AT KALPAKKAM (MAPS 1), AND THE EXPERIMENTAL REACTOR DHRUVA ALL WENT CRITICAL. INDIA BECAME THE WORLD'S SEVENTH COUNTRY TO BEGIN OPERATING A BREEDER REACTOR. THE TARAPUR POWER STATIONS CONTINUED TO OPERATE WELL ALBEIT AT A DERATED 160 MW. THE BARODA HEAVY WATER PLANT INCREASED PRODUCTION FOR THE THIRD YEAR IN A ROW AND IT SEEMS THAT THE KAKRAPAR, TAL, AND MANHURU PLANTS ARE STILL ON SCHEDULE. THE NARINI RESEARCH REACTOR MAY BE COMMISSIONED BY THE END OF THE YEAR. DAE OFFICIALS HAVE BEEN CONDUCTING SIGNIFICANT RESEARCH INTO NUCLEAR FUELS AND HOPE EVENTUALLY TO FUEL THEIR POWER REACTORS WITH THORIUM-PLUTONIUM FUEL RATHER THAN URANIUM.

6. ON THE NEGATIVE SIDE, AN EXPLOSION AND FIRE SHUT DOWN THE TALCHER HEAVY WATER PLANT IN APRIL. IN AUGUST, DAE OFFICIALS GAVE UP ATTEMPTING TO REPAIR THE FIRST KAKRAPAR REACTOR (MAPS 1). THE FIRST KALPAKKAM REACTOR (MAPS 1) WAS OUT FOR FOUR MONTHS WHILE ITS GENERATOR TRANSFORMER WAS REPLACED. BEFORE IT WAS OPERATING AGAIN, A FUEL TANK LEAK CONTAMINATED SEVEN TONS OF ITS HEAVY WATER. DAE OFFICIALS PUBLICLY RECOGNIZED THAT DHRUVA HAS NOT WORKED NEARLY FROM ITS INCEPTION. ASPARA IS SHUT DOWN, AND CIRUS IS OPERATING AT HALF POWER.

7. ALTHOUGH THE UNITED STATES IS NOT PROVIDING ANY ASSISTANCE TO INDIA'S NUCLEAR ENERGY PROGRAM, INDIA DOES HAVE CONTACTS WITH WESTERN EUROPEAN COUNTRIES

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C O N F I D E N T I A L SECTION 02 OF 22 NEW DELHI 22414

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AND WITH JAPAN. DAE IS ABLE TO OBTAIN RELATED, THOUGH NOT DIRECT NUCLEAR, TECHNOLOGY (E.G., ELECTRONICS SYSTEMS) FROM THESE ADVANCED COUNTRIES WHEN THE UNITED STATES DOES NOT PROVIDE ASSISTANCE.

8. DAE OFFICIALS VEHEMENTLY DENIED RECENTLY PUBLISHED CHARGES THAT INDIA WAS ACQUIRING A NUCLEAR WEAPON CAPABILITY, THAT SAFEGUARDED HEAVY WATER HAD BEEN ILLEGALLY DIVERTED TO UNSAFEGUARDED REACTORS, AND THAT INDIA WAS IMPORTING HEAVY WATER FROM CHINA. THEY ALSO CONTINUED TO PROVIDE POST-CHEMNOBIL SAFETY ASSISTANCE, STRESSING THAT, "IT CAN'T HAPPEN HERE." END SUMMARY.

9. THIS REPORT IS DIVIDED INTO THE FOLLOWING SECTIONS.

- INDIA'S ENERGY NEEDS
- INDIA'S NUCLEAR POWER STRATEGY
- DEPARTMENT OF ATOMIC ENERGY
- DAE BUDGET
- NUCLEAR POWER COSTS
- NUCLEAR POWER PLANTS
- HEAVY WATER PLANTS
- FAST BREEDER REACTORS
- RESEARCH REACTORS
- REPROCESSING
- RADIOACTIVE WASTE MANAGEMENT
- NUCLEAR RESEARCH
- SAFETY
- NEOUS NUCLEAR COOPERATION

-- COMMENT

10. EMBASSY ACKNOWLEDGES AND APPRECIATES AMCONGEN BOMBAY'S ASSISTANCE IN THE INITIAL PREPARATION OF THE REPORT. THE EMBASSY WILL UPDATE THIS REPORT ANNUALLY. WE ARE ALSO PREPARING A COUNTRY WIDE ASSESSMENT OF THE ELECTRIC POWER SITUATION IN INDIA AS AN UPDATE OF 84 NEW DELHI 02731.

INDIA'S ENERGY NEEDS

11. INDIA TODAY CONSUMES OVER 150 BILLION KILOWATT HOURS (KWH) OF ELECTRICITY ANNUALLY AND THAT FIGURE IS INCREASING. BY THE YEAR 2000, DAE PROJECTIONS SEE CONSUMPTION AS ALMOST TRIPLING, TO 400 BILLION KWH. THIS, HOWEVER, IS ONLY PART (ABOUT 20 PERCENT) OF INDIA'S ENERGY CONSUMPTION. COMMERCIAL ENERGY REQUIREMENTS OF TWICE THIS AMOUNT ARE MET BY SOURCES OTHER THAN ELECTRICITY. NON COMMERCIAL SOURCES OF ENERGY (FIREWOOD, DUNG, MANUAL AND ANIMAL LABOR, AGRICULTURAL WASTE) PROVIDE THE REMAINING 80 PERCENT OF INDIA'S TOTAL ENERGY REQUIREMENTS.

12. VARIOUS GOI AND DAE PROJECTIONS ESTIMATE THAT INDIA'S INSTALLED ELECTRICAL GENERATING CAPACITY SHOULD INCREASE FROM TODAY'S 45,000 MW TO 100,000 OR 120,000 MW BY THE YEAR 2000 IN ORDER TO MEET THE COUNTRY'S EVER INCREASING COMMERCIAL ENERGY NEEDS. THERE ARE ONLY THREE PRINCIPAL SOURCES OF ENERGY IN INDIA WHICH CAN BE EXPECTED TO PLAY MAJOR ROLES ON A COMMERCIAL SCALE FOR GENERATING ELECTRICITY:

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HYDRO-ELECTRIC. COAL, AND NUCLEAR.

13. OIL AND NATURAL GAS. THOUGH USED EXTENSIVELY FOR TRANSPORTATION, FOR HOME COOKING AND LIGHTING, AND IN THE PETRO-CHEMICAL INDUSTRY, ARE NOT USED MUCH FOR GENERATING ELECTRICITY IN INDIA. INDIA IS EXPECTED TO NEED 90 MILLION TONS OF PETROLEUM ANNUALLY BY THE YEAR 2000 OF WHICH ONLY 50 TO 60 PERCENT WILL BE DOMESTICALLY PRODUCED. EVEN IF NATURAL GAS FIELDS ARE DEVELOPED EXTENSIVELY, THE NATURAL GAS IS EXPECTED

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TO BE BURNED DIRECTLY RATHER THAN USED TO GENERATE

ELECTRICITY. ON THESE GROUNDS, GOI PLANNERS RULE

OUT USING PETROLEUM AND NATURAL GAS TO GENERATE MUCH

ELECTRICITY FOR THE COUNTRY.

14. HYDRO-ELECTRIC POWER IS THE ONLY AVAILABLE RENEWABLE RESOURCE OF ENERGY FOR RISK ELECTRICITY GENERATION:

INDIA HOPES TO EXPLOIT IT TO THE GREATEST EXTENT POSSIBLE. BUT HYDRO-ELECTRIC PLANTS CAN BE CONSTRUCTED ONLY AT SPECIFIC LOCATIONS. THEY INVOLVE HIGH CAPITAL COSTS, AND THEY HAVE LONG GESTATION PERIODS RESULTING FROM THEIR BEING MULTIPURPOSE HYDRO-AGRICULTURAL OPERATIONS. NEW HYDRO-ELECTRIC PROJECTS ARE ALSO ENCOUNTERING ENVIRONMENTAL AND POLITICAL DIFFICULTIES DUE TO THEIR SUBMERGING FORESTED AREAS AND UPROOTING

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LARGE NUMBERS OF PEOPLE. OF THE 75,000 MW OF HYDRO-ELECTRIC POTENTIAL IN INDIA. ONLY 20 PERCENT HAS BEEN EXPLOITED SO FAR. PLANS CALL FOR THIS TO BE DOUBLED WITHIN THE NEXT 15 YEARS.

15. AT PRESENT, COAL IS INDIA'S MAJOR SOURCE FOR GENERATING ELECTRICITY PRODUCING MORE THAN 60 PERCENT OF THE COUNTRY'S ELECTRICITY. COAL WILL CONTINUE TO PLAY A MAJOR ROLE IN THE FUTURE. BY THE YEAR 2002, THE INSTALLED CAPACITY OF COAL-FIRED ELECTRICITY PLANTS IS EXPECTED TO DOUBLE TO 50,000 MW OF THERMAL POWER. BUT THERE ARE CONSTRAINTS ON THE USE OF COAL AND THESE CONSTRAINTS WILL SERVE TO REDUCE THE SHARE OF ELECTRICITY GENERATED BY COAL.

16. ONLY ONE-FOURTH (LESS THAN 30 BILLION TONS) OF INDIA'S COAL RESERVES ARE PROVEN. THE REST ARE EITHER INFERRED OR INDICATED. THE QUALITY OF INDIAN COAL IS

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VERY POOR, CONTAINING 35 PERCENT OR MORE OF ASH AND NONCOMBUSTIBLES. MOST OF THE NEW THERMAL PLANTS WILL HAVE TO BE LOCATED NEAR THE MINES IN BIHAR AND MADHYA PRADESH TO MINIMIZE TRANSPORTATION AND ENVIRONMENTAL COSTS. FURTHER, ACCORDING TO DAE FIGURES, A 1000 MW

THEMAL STATION OPERATING AT 60 PERCENT CAPACITY WILL NEED OVER 10,000 TONS OF COAL DAILY (FIVE TO SEVEN TRAINLOADS), WILL PRODUCE OVER ONE MILLION TONS OF ASH EACH YEAR, AND WILL DISCHARGE 50 TONS OF POISONOUS SULPHUR DIOXIDE DAILY.

17. IT IS AGAINST THIS BACKGROUND THAT THE DAE PROPOSED A 15 YEAR NUCLEAR POWER PROGRAM FOR INDIA. A PROGRAM IN WHICH 10,000 MW OF NUCLEAR GENERATING CAPACITY IS TO BE INSTALLED BY THE YEAR 2000. (THE 10,000 MW GOAL IS PART OF THE OVERALL PLAN TO PROVIDE ENOUGH PLUTONIUM FOR A SELF-SUSTAINING BREEDER CYCLE DURING THE SECOND PHASE OF INDIA'S NUCLEAR POWER PROGRAM.) BECAUSE INDIAN HYDRO-ELECTRIC, THERMAL, AND NUCLEAR PLANTS REQUIRE EIGHT TO FIFTEEN YEARS FROM THE DESIGN STAGE TO BECOME FULLY OPERATIONAL, INDIA MUST PLAN NOW FOR THE ELECTRICITY IT HOPES TO HAVE BY THE YEAR 2000.

INDIA'S NUCLEAR POWER STRATEGY

18. INDIGENIZATION, OR SELF-RELIANCE, IN DEVELOPING INDIAN NUCLEAR POWER GENERATION IS THE GOI GOAL. INDIA IS WORKING TOWARD MAXIMUM NATIONAL SELF-SUFFICIENCY IN MASTERING THE ENTIRE NUCLEAR CYCLE -- FROM MINING TO WASTE DISPOSAL.

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19. INDIA'S NUCLEAR POWER BOARD (NPB) OPERATES SIX
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NUCLEAR REACTORS HAVING A COMBINED CAPACITY OF 1,238 MW. THESE ARE LOCATED AT TARAPUR (TAPS -- TWO REACTORS AT 210 MW EACH), RAJASTHAN (RAPS -- TWO REACTORS AT 220 MW EACH), AND KALPAKHAM, NEAR MADRAS, (KAPS -- TWO REACTORS AT 235 MW EACH). INSTALLED CAPACITY IS EXPECTED TO INCREASE TO 1,700 MW BY 1990 AND TO 2,170 MW BY 1992. BY 1995, REACTORS NOW UNDER CONSTRUCTION SHOULD HAVE A CAPACITY OF 3,110 MW. BY 1990, INSTALLED CAPACITY IS SUPPOSED TO REACH 5,000 MW AND BY THE YEAR 2020, THE GOI PLANS TO HAVE 10,050 MW OF INSTALLED NUCLEAR POWER GENERATION CAPACITY IN 30 REACTORS (12 ADDITIONAL REACTORS AT 235 MW EACH AND 18 REACTORS AT 500 MW EACH).

20. DURING 1985-86, INDIA'S POWER REACTORS GENERATED ALMOST FIVE BILLION KILOWATT HOURS (KWH) OF ELECTRICITY, UP FROM 3.5 BILLION TWO YEARS EARLIER. FROM MEETING ABOUT THREE PERCENT OF INDIA'S ELECTRICITY NEEDS NOW, GOI OFFICIALS BELIEVE NUCLEAR POWER WILL MEET TEN PERCENT OF INDIA'S ELECTRICITY NEEDS IN THE YEAR 2000. GOI AND DAE OFFICIALS CONTINUE TO REMAIN PUBLICLY OPTIMISTIC ABOUT ATTAINING THIS GOAL IN SPITE OF ITS ACCOMPANYING HEAVY FINANCIAL COSTS, CONSTRUCTION DELAYS, OPERATIONAL PROBLEMS, AND PERIODIC PRESS CRITICISM. WE SUSPECT, HOWEVER, THAT THEIR GOAL IS TOO AMBITIOUS.

21. DAE OFFICIALS CONSIDERABLY ARGUE THAT THEIR IS AN ACHIEVABLE GOAL. WHETHER OR NOT IT IS REACHED, THEY SAY, DEPENDS LARGELY ON THE FOLLOWING FACTORS:

- (A) WILL ENOUGH MONEY BE ALLOCATED TO PAY FOR THE NEW PLANTS?
- (B) WILL INDIA BE ABLE TO OVERCOME HER HEAVY WATER PLANT PROBLEMS?
- (C) AS THE PROGRAM CONTINUES AND THEY GET MORE EXPERIENCE, WILL THE INDIAN MANUFACTURERS BE ABLE TO PRODUCE HIGH QUALITY EQUIPMENT ON TIME?

22. DURING THE LAST YEAR, THE GOI HAS USED THE NEW FINANCIAL CENTRAL GOVERNMENT. THE GOI HAS USED THE NEW FINANCIAL

FLAT BOND, AND TO RAISE ITS ELECTRICITY TARIFF RATES TO INCREASE ITS AVAILABLE FUNDS. THE GOI DOES NOT WANT TO CONTINUE SUBSIDIZING EITHER NUCLEAR GENERATED ELECTRICITY OR THE AEC'S MASSIVE CONSTRUCTION COST. INDIA'S HEAVY WATER PROBLEMS WILL BE OVERCOME. HEAVY WATER PRODUCTION WILL CERTAINLY INCREASE, THOUGH; IF ONLY BECAUSE MORE AND LARGER PLANTS ARE BEING BUILT INCORPORATING DESIGN AND OPERATING CHANGES TO HOPEFULLY ELIMINATE PROBLEMS ASSOCIATED WITH EXISTING HEAVY WATER PLANTS.

23. WITH REGARD TO THE THIRD POINT, DAE CHAIRMAN DR. RAJA RAMANNA HAS EMPHASIZED HIS EXPECTATION THAT INDIAN MANUFACTURERS WILL BE INCREASINGLY ABLE TO PUT OUT QUALITY PRODUCTS ON TIME AS INDIA'S NUCLEAR PROGRAM PROGRESSES. THESE MANUFACTURERS WILL BE HELPED, HE FEELS, BY INCREASING NUMBERS OF ORDERS, STANDARDIZED POWER PLANT DESIGN (235 MW AND 500 MW REACTORS ONLY), ADVANCED PROCUREMENT OF CRITICAL MATERIAL, PREFABRICATED MATERIALS, ON-SITE CONSTRUCTION, AND CONTINUING ADHERENCE TO HIGH QUALITY STANDARDS. THESE CRITERIA LEAD HIM AND OTHERS TO PREDICT INCREASINGLY FEWER POST-COMMISSIONING PROBLEMS. RAMANNA NOTED RECENTLY THAT MOST NUCLEAR PLANT SHUTDOWNS ARE DUE TO CONVENTIONAL, NOT NUCLEAR ITEMS. HE SAID DAE HAD TO BUY WHAT IT COULD GET IN INDIA AND THAT QUALITY IMPROVEMENT CONTINUED AS THEY TOLD THE MANUFACTURERS WHAT WAS WRONG WITH THEIR PRODUCTS. RAMANNA CITED THE KALPAKHAM NUCLEAR POWER STATION AND THE THAL AND MANJURU HEAVY WATER PLANTS, WHICH HE SAID WOULD BE COMPLETED ON OR AHEAD OF SCHEDULE, AS EVIDENCE THAT MAJOR DELAYS IN COMMISSIONING ARE THINGS OF THE PAST.

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24. OTHER FACTORS WHICH COULD IMPINGE ON ACHIEVING THE GOAL OF 10,000 MW BY THE YEAR 2000 ARE THE NEED TO INCREASE URANIUM PRODUCTION (NOW AT 130 TONS PER YEAR) AND THE AVAILABILITY OF TRAINED MANPOWER TO (CORRECTLY AND SAFELY) OPERATE THE INCREASING NUMBER OF NUCLEAR POWER STATIONS. THE AEC ESTIMATES INDIA'S URANIUM RESERVE AT 73,900 TONS (INDICATED AND INFERRED). MAJOR DEPOSITS ARE IN BIHAR, MADHYA PRADESH, KARNATAKA, RAJASTHAN, AND MEGHALAYA. BY THE END OF THE DECADE, THE URANIUM CORPORATION OF INDIA EXPECTS TO HAVE FOUR MINES IN OPERATION (VS ONE NOW) IN ADDITION TO A URANIUM RECOVERY PLANT TO EXTRACT URANIUM FROM COPPER TAILINGS FROM HINDUSTAN COPPER LIMITED.

25. MANPOWER SHOULD NOT BE A PROBLEM. AT PRESENT, DAE HAS ALMOST 32,500 STAFF OF WHICH OVER 21,500 ARE SCIENTISTS AND TECHNICIANS. THIS LAST GROUP HAS BEEN GROWING AT ABOUT THREE PERCENT ANNUALLY; MANY ARE TOP QUALITY PEOPLE. A GOOD MANY OF THE LEADERS HAVE BEEN EDUCATED IN EUROPE, THE UNITED STATES, OR AT ONE OF INDIA'S IITS.

DEPARTMENT OF ATOMIC ENERGY

26. DR. RAJA RAMANNA, ATOMIC ENERGY COMMISSION (AEC) CHAIRMAN AND DAE SECRETARY, IS STILL FULLY IN CHARGE

UNDERTAKINGS (INDIAN RARE EARTHS LIMITED, URANIUM CORPORATION OF INDIA LIMITED, AND ELECTRONICS CORPORATION OF INDIA LIMITED). DAE ALSO RUNS THE BHABHA ATOMIC RESEARCH CENTER (BARC), THE INDIRA GANDHI CENTER FOR ATOMIC RESEARCH (ICAR), AND THE CENTER FOR ADVANCED TECHNOLOGY (CAT) AND OTHER INSTITUTES.

28. THE ATOMIC ENERGY COMMISSION, OF WHICH DR. RAMANNA IS THE CHAIRMAN, IS A NINE PERSON BODY WHICH ADVISES THE GOI ON ATOMIC ENERGY MATTERS. MR. SHIVRAJ PATIL, MINISTER OF STATE FOR SCIENCE AND TECHNOLOGY, ATOMIC ENERGY, SPACE, ELECTRONICS, AND OCEAN DEVELOPMENT, OVERSEES THE OPERATION OF DAE AND ANSWERS PARLIAMENTARY QUESTIONS RELATING TO ATOMIC ENERGY MATTERS.

DAE BUDGET

(ALL DOLLAR FIGURES IN THIS AND SUCCEEDING SECTIONS ARE FIGURED AT US\$100 1.00 RS. 12.50)

29. THE INDIAN NATIONAL PLAN BUDGET FOR 1986-87 (APRIL 1-MARCH 87) PROVIDED APPROXIMATELY DOLLARS 440 MILLION FOR THE DEPARTMENT OF ATOMIC ENERGY, A FIVE PERCENT INCREASE OVER THE 1985-86 REVISED BUDGET ESTIMATES. THE NUCLEAR POWER ALLOCATION OF 175.5 MILLION DOLLARS REPRESENTS A 24 PERCENT INCREASE WHILE THE HEAVY WATER PROJECT ALLOCATION OF DOLLARS 130 MILLION SHOWS AN 18 PERCENT DECREASE. THE RESEARCH AND DEVELOPMENT ALLOCATION OF DOLLARS 38.5 MILLION IS UP SIX PERCENT FROM LAST YEAR. THE PLAN BUDGET BREAKDOWN FOLLOWS.

30. THE DEPARTMENT OF ATOMIC ENERGY WITH OVER 300 PERSONNEL, IS COMPOSED OF SEVERAL SUBDIVISIONS. THE NUCLEAR POWER DIVISION (NPD) OVERSEES THE PRESENT AND FUTURE NUCLEAR POWER PROJECTS. THE HEAVY WATER PROJECTS SECTION, HEADLED BY DR. H. S. GANDHI, OVERSEES ALL THE HEAVY WATER PLANTS AND PROJECTS. ADDITIONAL BRANCHES OF THE DAE INCLUDE THE NUCLEAR FUEL COMPLEX, THE ATOMIC MINERALS DIVISION, AND THE ATOMIC ENERGY RESEARCH AND DEVELOPMENT DIVISION.

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-1986-87 PLAN BUDGET FOR THE DEPARTMENT OF ATOMIC ENERGY

-- CATEGORY	MILLIONS OF DOLLARS
- NUCLEAR POWER (INCLUDES ALL NUCLEAR POWER STATIONS AND ADVANCE PROCUREMENT)	175.54
- OTHER PROJECTS	24.39
--- TOTAL NUCLEAR POWER AND ENERGY	199.93
- ENRG (INCLUDES REPROCESSING PLANTS AT TARAPUR AND RAJAPUR)	24.72
- HEAVY WATER PROJECTS	129.73
- MINERALS (INCLUDES NUCLEAR FUEL COMPLEX, INDIAN RARE EARTHS, URANIUM CORPORATION, ETC.)	37.15
--- TOTAL INDUSTRY AND MINERALS	281.68
- RESEARCH AND DEVELOPMENT (INCLUDES ENRG, CAT, REC, ATOMIC MINERALS DIVISION AND OTHER)	38.47
--- TOTAL	440.60
	(RS. 558 CRORE)

39. IT APPEARS THAT PLAN MONEY, IN ADDITION TO THE DOLLAR 175.5 MILLION HAS BEEN BUDGETED FOR CAPITAL DISBURSEMENTS FOR THE NUCLEAR POWER STATIONS. IN THE EXPLANATORY MEMORANDUM ON THE CENTRAL GOVERNMENT BUDGET, PUT OUT BY THE MINISTRY OF FINANCE, THE FOLLOWING ADDITIONAL AND NET ARE RECEIVED DERIVED

	MILLIONS OF DOLLARS
-- TARAPUR ATOMIC POWER STATION	4.22
-- RAJAPUR ATOMIC POWER STATION	4.40
-- 500 MW FACILITY	20

-- WASTE MANAGEMENT FACILITIES	2.31
-- OTHER PROJECTS	4.65
---	----
--- MINIMUM TOTAL ADDITIONAL PLAN FUNDING	16.46

31. IN ADDITION TO THE PLAN BUDGET, THE ATOMIC ENERGY DEVELOPMENT PROGRAM ALSO RECEIVES NON-PLAN FUNDING. THE 86-87 GOI BUDGET ESTIMATES THIS NON-PLAN EXPENDITURE OF DOLLAR 67.2 MILLION TO BE OFFSET BY REVENUES AMOUNTING TO DOLLAR 59.4 MILLION. ADDITIONAL PROJECTED NON-PLAN FUNDING FOR THE THREE ATOMIC POWER PLANTS IS GIVEN BELOW.

	MILLIONS OF DOLLARS
TARAPUR ATOMIC POWER STATION	
-- EXPENDITURE	46.4
-- RECEIPTS (FROM SALE OF POWER)	(57.5)
RAJASTHAN ATOMIC POWER STATION	
-- EXPENDITURE	52.8
-- RECEIPTS	(63.7)
MADRAS ATOMIC POWER STATION	
-- EXPENDITURE	51.9

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FM AMEMBASSY NEW DELHI
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INFO AMEMBASSY BEIJING
AMEMBASSY ISLAMABAD
AMEMBASSY OTTAWA
AMEMBASSY PARIS
AMEMBASSY VIENNA
AMCONSUL BOMBAY
AMCONSUL CALCUTTA
AMCONSUL MADRAS

C O N F I D E N T I A L SECTION 07 OF 22 NEW DELHI 22414

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SUBJ: INDIA'S NUCLEAR ENERGY PROGRAM

-- RECEIPTS

(07.2)

32. A THIRD AMOUNT, AN ADDITIONAL DOLLAR 25.9 MILLION, IS PROVIDED IN THE BUDGET AS AN ESTIMATE OF NON-PLAN CAPITAL EXPENSE TOWARD ATOMIC ENERGY DEVELOPMENT. THIS ENTIRE AMOUNT OF MONEY IS ALLOCATED FOR EXISTING HEAVY WATER PLANTS. NO NON-PLAN CAPITAL EXPENDITURES HAVE BEEN BUDGETED FOR EXISTING OR FUTURE NUCLEAR POWER STATIONS.

33. THUS INDIA'S ATOMIC ENERGY PROGRAM SHOULD RECEIVE US\$46.5 MILLION IN PLAN FUNDS DURING FY 1986-87 AND US\$45.8 MILLION IN NON-PLAN FUNDS. THE NON-PLAN FUNDING IS EXPECTED TO BE COVERED BY REVENUES US\$46.6 MILLION, LARGELY FROM THE SALE OF NUCLEAR POWER.

NUCLEAR POWER COSTS

34. THE INSTALLED COST PER MEGAWATT (MW) AT TARAPUR WAS ABOUT 13 CENTS (RS. 1.6). ELECTRICITY FROM TAPS HAS BEEN SOLD AT LESS THAN 30 PAISA (100 PAISA PER RUPEE) PER KILOWATT HOUR (KWH); IT IS NOW UP TO ABOUT 3 CENTS (30 PAISA) BUT IS STILL LOWER THAN THE COST OF THERMAL POWER IN THE REGION (MORE THAN 3-1/2 CENTS (45 PAISA) PER KWH). THE INSTALLED COST AT RAPO WAS ABOUT 32 CENTS (RS. 4) PER KWH. ITS ELECTRICITY SELLS FOR AROUND 40 PAISA PER KWH VERSUS THE REGION'S THERMAL COST OF 40-50 PAISA PER KWH, ABOUT 4-1/2 CENTS. RAPO ELECTRICITY SELLS FOR AROUND 45 PAISA VERSUS THERMAL COSTS OF OVER 5 CENTS (60 PAISA).

35. INDIAN CONSUMERS HAVE BEEN PAYING 1 PAISA PER KWH OF ELECTRICITY TOWARD DECOMMISSIONING COST OF EACH REACTOR CAPTIALIZED AT 10 PER CENT COMPOUND INTEREST. DUE PROJECT, THIS ONE CAME AHEAD 100,000 AND 100,000 CRORE RUPEES. BECAME 100 CRORE RUPEES, US\$ 104 MILLION.

AT CURRENT PRICES/RATES) AT THE END OF A REACTOR'S LIFE.

36. TOTAL REVENUES TO DATE FROM THE SALE OF POWER, ACCORDING TO THE COMMISSIONER, OF THE 517 NUCLEAR POWER PLANTS ARE OVER US\$ 600 MILLION (RS. 750 CRORE). ADDITIONAL INCOME OF 20-25 PERCENT OF THIS FIGURE IS EXPECTED ANNUALLY FOR THE NEXT FEW YEARS. IN CONTRAST, RAMANNA SAID THAT THEIR COMBINED FINAL TOTAL PROJECT COSTS WERE SOME US\$ 400 MILLION (500 CRORE RUPEES). HOWEVER, ADDING ANNUAL OPERATING COSTS, NOW ESTIMATED AT US\$ 100 MILLION AND CERTAINLY IN EXCESS OF US\$ 50 MILLION FOR THE PAST SEVERAL YEARS, CLEARLY SHOWS THAT NUCLEAR POWER IS A MONEY-LOSER FOR INDIA. DR. P.K. IYENGAR, BARC DIRECTOR, HAS STATED THAT HE BELIEVES INDIAN NUCLEAR POWER WILL BECOME PROFITABLE BY THE MID 1990'S.

NUCLEAR POWER PLANTS

37. FOLLOWING IS A LISTING OF INDIA'S PRESENT NUCLEAR POWER PLANTS AND THOSE UNDER CONSTRUCTION:

PLANT	DATE OF COMMISSIONING	DESIGN CAPACITY (MW)	EFFECTIVE CAPACITY (MW)
TAPS I	1969	210	158
TAPS II	1969	210	168

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SUBJ: INDIA'S NUCLEAR ENRGY PROGRAM

RAPS I	1972	220	NONE
RAPS II	1973	220	210
MAPS I	1984	235	220
MAPS II	1985	235	220
NAPP I	1988	235	220
NAPP II	1989	235	220
KAPP I	1991	235	220

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KAPP II	1992	235	220
KAIGA I	1994	235	--
KAIGA II	1995	235	--
RAPS III	1994	235	--
RAPS IV	1995	235	--

38. TARAPUR ATOMIC POWER STATION

(TAPS)--THIS "VINTAGE" 3rd-BUILT PLANT, NEAR BOMBAY.

WILL HAVE COMPLETED 17 YEARS OF COMMERCIAL

OPERATION ON NOVEMBER 1, 1986. DURING 1985.

TAPS II ACHIEVED AN AVAILABILITY FACTOR OF 92 PERCENT AND A CAPACITY FACTOR OF 84 PERCENT. THE CORRESPONDING FIGURES FOR TAPS I WERE 71 AND 82 PERCENT. IN A JUNE 1986 PRESS INTERVIEW.

DR. SRINIVASAN, CHAIRMAN OF DAE'S NUCLEAR POWER BOARD, SAID THAT THE TARAPUR REACTORS ARE OPERATING AT 160 MW RATHER THAN AT THEIR ORIGINAL DESIGN CAPACITY OF 210 MW. THESE

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UNITS WERE DERATED TO PREVENT LEAKS IN THE TUBES OF THE FACILITY'S FOUR STEAM GENERATORS. THESE LEAKS REAPPEARED REGULARLY. DESPITE REPAIRS, UNTIL IT WAS DISCOVERED THAT DERATING TO 162 MW ELIMINATED THE LEAKS. THIS REDUCTION MAY SOLVE THE TAPS REACTORS' PERSISTENT PROBLEM OF FUEL CONTAMINATION OF THE COOLANT. (UNDER STRESS, THE FUEL ROD CLADDING DEVELOPS FINEHOLES SO THAT RADIOACTIVE FISSION PRODUCTS AND GASES LEAK OUT INTO THE COOLANT. THE CIRCULATING COOLANT, AND LEAKS BETWEEN THE PRIMARY AND SECONDARY COOLANT CHANNELS, SPREAD THE RADIOACTIVITY THROUGHOUT

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ALMOST THE ENTIRE PLANT.) STILL TO BE SOLVED ARE FREQUENT FAILURES OF ITS ELECTRIC GAUGES AND ITS ALARM AND CONTROL SYSTEMS.

39. TARAPUR FUEL AND SPARE SUPPLY NO LONGER CONSTITUTE INDO-US PRIEMS. THE FRENCH HAVE SUPPLIED LOW-ENRICHED URANIUM SINCE 1983 AND INDIAN MANUFACTURERS ARE PROVIDING AN INCREASING NUMBER OF SPARE PARTS OFFSETTING THE LIMITED AVAILABILITY FROM THE ORIGINAL US AND FRG SUPPLIERS.

43. TARAPUR'S SPENT FUEL STORAGE POOL WAS AUGMENTED IN 1985 BY INSTALLING TWO MORE HIGH DENSITY STAINLESS STEEL RACKS. SINCE

FURTHER AUGMENTATION OF THE POOL IS NOT POSSIBLE, AN AWAY-FROM-REACTOR (AFR) FUEL STORAGE FACILITY WILL BE BUILT TO FACILITATE REFUELING OF TAPS BEYOND 1986. THE DISPOSITION OF THIS SPENT FUEL CONTINUES TO BE A POSSIBLE ISSUE IN FUTURE INDO-US RELATIONS SINCE THE USG VIEW IS THAT ALL REPROCESSING MUST BE UNDER SAFEGUARDS BECAUSE THE REACTOR AND FUEL ARE SAFEGUARDED.

41.

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TAGS: FM27. IP27. WFRP. IN

SUBJ: INDIA'S NUCLEAR ENERGY PROGRAM

AND GLANDS AS WELL AS A MAJOR DESIGN FAILURE

INVOLVING THE UNEXPECTED TENDENCY OF ITS PRESSURE

TUBES--THE COOLANT CHANNELS THAT CONTAIN

THE FUEL PELLETS IN THE CORE--TO EXPAND IN

LENGTH.) DR. SRINIVASAN RECENTLY TOLD THE

PRESS THAT EVERYTHING POSSIBLE HAD BEEN DONE

TO REPAIR THE LEAK BUT WITH NO SUCCESS.

BECAUSE REPAIR IS NO LONGER CONSIDERED POSSIBLE.

THE ONLY OPTIONS REMAINING ARE TO REPLACE THE

END SHIELD OR WRITE OFF THE REACTOR. (SOME

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ATTEMPTS MAY ALSO BE MADE TO OPERATE THE

REACTOR AT LOW POWER TO PROVIDE STEAM TO THE

NEARBY KOTA HEAVY WATER PLANT.)

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40ST

RECENT PRESS REPORTS INDICATE THAT IAF IS

CONSIDERING SEALING THE REACTOR AND JUST

LEAVING IT IN POSITION AFTER DRAINING ITS

HEAVY WATER AND REMOVING ITS FUEL. PAPS I

HAS NEVER MADE MONEY AND IT LOSTS MORE MONEY EVERY

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DAY IT OPERATES. THE DR. SRINIVASAN SAID THAT
THE AEC STILL WOULD LIKE TO FIX THE REACTOR.
NO DOUBT THEY WOULD WELCOME ASSISTANCE,
ESPECIALLY WITH THE ROBOTICS NECESSARY.
FROM ALL QUARTERS. //

B1, A5

43. THE SECOND RAPS REACTOR. HOWEVER, HAS BEEN
PERFORMING ADEQUATELY. DURING 1985, RAPS II
ACHIEVED A CAPACITY FACTOR OF 57 PERCENT AND AN
AVAILABILITY FACTOR OF 71 PERCENT. IT IS
SAID TO HAVE ATTAINED ITS 220 MW CAPACITY LAST
NOVEMBER. THE DAF HAS RECENTLY PROPOSED TO
FUEL THE RAPS REACTOR (AND, POSSIBLY RAPS III
AND IV, SCHEDULED FOR COMPLETION IN LESS THAN
TEN YEARS) WITH THORIUM-PLUTONIUM FUEL RATHER

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THAN WITH URANIUM. (INSIDE THE REACTOR,
THORIUM WOULD BE CONVERTED TO U-233.)
DR. P.V. IYENGAR, BARC DIRECTOR, SAID THIS
AUGUST THAT BARC HAS ALREADY PRODUCED AND
TESTED THORIUM-PLUTONIUM FUEL CLUSTERS.
BARC RESEARCHERS PREDICT THESE FUEL CLUSTERS
WILL PROVIDE ALMOST TWICE THE ENERGY PER TON
AS DOES URANIUM.

B1, A5

44. MADRAS ATOMIC POWER STATION (MAPS)--
INDIAN SCIENCE OFFICIALS ARE VERY PROUD OF
THIS ALMOST COMPLETELY INDIGENOUS PLANT.
WHEN THEY ARE OPERATING, THE MAPS REACTORS
ARE PERFORMING ADEQUATELY. MAPS I, THOUGH,
HAS BEEN PLAGUED WITH PROBLEMS. DURING
1985, THE REACTOR ACHIEVED A 46 PERCENT
CAPACITY FACTOR AND A 55 PERCENT AVAILABILITY
FACTOR, BOTH DOWN ABOUT 15 PERCENTAGE POINTS FROM
1984. VIBRATION IN THE TURBINE
GENERATOR CAUSED TWO MAJOR OUTAGES LAST YEAR.
IN ADDITION, IN MARCH, THE COIL INSULATION IN
THE REACTOR'S MAIN TRANSFORMER FAILED.
THE TRANSFORMER WAS REPLACED WITH ONE
DESTINED FOR KARUPA. FOUR MONTHS LATER,
MAPS I WAS GENERATING POWER AGAIN ONLY
TO BE TAKEN OUT THREE DAYS LATER TO
CORRECT A LEAKING PUMP. MAPS I IS BACK
ON LINE NOW. (DURING THE INITIAL TRIALS

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OF THE NEW GENERATOR-TRANSFORMER IN JUNE.
THE REACTOR LEAKED SEVEN TONS OF HEAVY
WATER, RESULTING IN A DECLARATION OF AN
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INCOMING
TELEGRAM

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TAGS: ENRG, TRCV, KPRP, IN
SUBJ: INDIA'S NUCLEAR ENERGY PROGRAM

IN-PLANT EMERGENCY. ACCORDING TO MAPS OFFICIALS,
NO RADIOACTIVITY WAS RELEASED INTO THE ENVIRONMENT.
MAPS II HAS BEEN OPERATING ONLY SINCE LAST
OCTOBER AND HAS BEEN IN COMMERCIAL USE ONLY
SINCE THIS MARCH. THE SECOND REACTOR
APPEARS TO BE OPERATING SOMEWHAT MORE
EFFECTIVELY THAN MAPS I. MAPS II WAS OUT
OF OPERATION FOR TWO WEEKS IN APRIL AND ONE
WEEK IN JULY DUE TO GENERATOR PROBLEMS.
IT HAS BEEN SHUT DOWN SINCE AUGUST 12 BECAUSE SOME
SPENT NUCLEAR FUEL RODS BECAME STUCK IN THE FUEL
TRANSPORT SYSTEM. ALTHOUGH THE TWO REACTORS ARE
EACH RATED AT 235 MW, MAPS OFFICIALS ARE FULLY
SATISFIED WHEN THE TWO REACTORS GENERATE A
COMBINED TOTAL OF 400-420 MW.

45. NARORA ATOMIC POWER PROJECT (NAPP) -- THE
TWO 235 MW UNITS UNDER CONSTRUCTION IN UTTAR PRADESH,
ABOUT 50 KM FROM THE EPICENTER OF A 1956
EARTHQUAKE, SHOULD BE GENERATING POWER
IN 1988 AND 1989, EIGHT YEARS BEHIND SCHEDULE.
THIS IS AN UNSAFEGUARDED INDIGENOUSLY DEVELOPED
PROJECT ORIGINALLY SCHEDULED FOR COMPLETION
IN 1981. DELAYS IN RECEIPT OF INDIA-MADE
COMPONENTS AND SITE MODIFICATIONS HAVE ALREADY
DOUBLED THE COST OF NAPP FROM 170 MILLION DOLLARS
IN 1974 TO 330 MILLION DOLLARS IN 1983.
A NEW GENERATOR-TRANSFORMER, TO REPLACE THE ONE
TAKEN FOR USE IN MAPS I, SHOULD BE ON SITE BY
EARLY NEXT YEAR.

46. KAKRAPAR ATOMIC POWER PROJECT (KAPP) --
THE TWO 235 MW REACTORS UNDER CONSTRUCTION
AT KAPP IN GUJARAT ARE EXPECTED TO BE
COMMISSIONED IN 1991 AND 1992. THE
CALANDRIA FOR UNIT I IS ON SITE AND THE
FABRICATION OF END SHIELDS AND CIRCULATING PUMPS
IS CONTINUING AS IS THE MAIN PLANT CIVIL WORK.
MANUFACTURE OF STEAM GENERATORS AND TURBO GENERATORS
SHOULD BEGIN SOON.

47. NEW PROJECTS -- WORK HAS BEGUN ON A NEW
SITE AT KAIGA, KARNATAKA, AND ON MAPS III AND IV.

EACH SITE WILL HAVE TWO 235 MW REACTORS WHICH
ARE DUE TO BE COMMISSIONED IN LESS THAN TEN
YEARS. THE SITE SELECTION COMMITTEE REPORT ON
ADDITIONAL SITES IS BEING CONSIDERED BY THE GOI.
(WE ARE AWARE THAT REQUESTS HAVE BEEN MADE BY
WEST BENGAL AND BY KERALA FOR NUCLEAR POWER
PLANTS.) A PROJECT REPORT ON FUTURE 500 MW
PLANTS IS IN PROGRESS. EMBASSY UNDERSTANDS
THAT THE FIRST 500 MW ATOMIC POWER PLANTS WILL
BE LOCATED NEAR MADRAS/KALPAKKAM, IN RAJASTHAN,
AND AT KAIGA.

48. EARLIER THIS DECADE, THE GOI WAS
CONSIDERING A SOVIET OFFER OF TWO 440 MW LIGHT
WATER ENRICHED URANIUM REACTORS. THIS PAST
AUGUST, THE INDIAN PRESS REPORTED THAT THE GOI
HAD OFFICIALLY DECLINED THE SOVIET OFFER. THE
DECISION WAS SAID TO HAVE BEEN MADE BEFORE CHERNOBYL
AND TO HAVE BEEN BASED ON LOGISTICS AND ON THE
INCOMPATIBILITY OF THE SOVIET REACTORS WITH THE
INDIAN HEAVY WATER NUCLEAR PROGRAM.

HEAVY WATER PLANTS

49. INDIGENOUS HEAVY WATER IS VITAL TO THE
DEVELOPMENT OF INDIA'S NUCLEAR ENERGY PROGRAM.
REFTEL (C) REPORTED THAT DR. M.R. SRINIVASAN,
CHAIRMAN OF THE AEC NUCLEAR POWER BOARD,
STATED THAT ONE OF THE MAJOR PROBLEMS THAT

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TAGS: ENRG, TRUY, NRP, IN
SUBJ: INDIA'S NUCLEAR ENERGY PROGRAM

WOULD HAVE TO BE OVERCOME IN ORDER FOR
INDIA TO MEET HER GOAL OF 10,000 MW OF
INSTALLED NUCLEAR POWER BY THE YEAR 2000 WAS
THE PRODUCTION LEVEL OF HEAVY WATER. FOUR
OF INDIA'S SIX EXISTING NUCLEAR POWER REACTORS
AND ALL OF THE REMAINING ONE THAT WILL BE BUILT
THIS CENTURY REQUIRE HEAVY WATER TO REMAIN FREE
FROM SAFEGUARDS. INDIA'S INDIGENOUS NUCLEAR POWER
REACTORS MUST USE INDIGENOUSLY PRODUCED HEAVY
WATER; IMPORTED HEAVY WATER FROM MULT SOURCES
WOULD TRIGGER SAFEGUARDS.

50. GOI AND DAE OFFICIALS REPEATEDLY STATE
THAT INDIA IS SELF SUFFICIENT IN HEAVY WATER
PRODUCTION AND ONLY IMPORTS HEAVY WATER FOR RAPS
FROM THE USSR UNDER AN OPEN AGREEMENT WITH IAEA
SAFEGUARDS. DR. CRINIVASAN DECLARED
THAT THE MOST RECENT CHARGES THAT DAE WAS ACQUIRING
NUCLEAR WEAPONS CAPABILITY, THAT SAFEGUARDED
HEAVY WATER HAD BEEN ILLEGALLY DIVERTED TO UN-
SAFEGUARDED REACTORS, AND THAT INDIA WAS IMPORTING
HEAVY WATER FROM CHINA WERE ALL FALSE. IN
SUPPORT, HE EXPLAINED THAT THE RAPS 1 STARTUP
WAS DELAYED ONE YEAR BECAUSE SUFFICIENT HEAVY
WATER WAS NOT AVAILABLE ON SCHEDULE.

THE KOTA PLANT BEGAN PRODUCING HEAVY WATER IN
1985. DURING THE PER ON APRIL 1984 TO
MARCH 85, INDIA PRODUCED APPROXIMATELY 80 TONS
OF HEAVY WATER. WE ESTIMATE THAT IN THE MOST
RECENT FISCAL YEAR 1985-86, INDIA ALSO
PRODUCED AROUND 80 TONS. PRODUCTION FIGURES SHOULD
INCREASE BY ONE THIRD DURING THE CURRENT FISCAL
YEAR TO AN ESTIMATED 110 TONS.

51. FOLLOWING IS A LISTING OF INDIA'S
PRESENT AND PLANNED HEAVY WATER PLANTS. THE INSTALLED
CAPACITY FIGURES ARE THOSE GIVEN BY MINISTER OF
STATE FOR SCIENCE AND TECHNOLOGY, ATOMIC ENERGY,
SPACE, ELECTRICITY, AND OCEAN DEVELOPMENT
MR. SHIVRAJ V. PATIL TO THE LOP SABHA IN EARLY
MAY OF THIS YEAR.

PLANT	DATE OF COMMISSIONING	DESIGN CAPACITY	INSTALLED CAPACITY	ESTIMATED MAXIMUM CAPACITY
NARVAL				
PUNJAB	1967	14 TONS	14 TONS	12 TONS
TUTICORIN				
TAMIL NADU	1978	71 TONS	49 TONS	45 TONS
BARODA				
GUJARAT	1980	67 TONS	45 TONS	35 TONS
KOTA				
RAJASTHAN	1984	100 TONS	85 TONS	70 TONS
TALCHAR				
ORISSA	1986	63 TONS	50 TONS	?

51. PRODUCTION OF HEAVY WATER IN INDIA HAS BEEN
A SLOW PROCESS. INDIA'S HEAVY WATER PLANTS
CONTINUE TO FACE SUBSTANTIAL PROBLEMS RESULTING
FROM UNRELIABLE SUPPLY OF POWER AND OTHER INPUTS
AS WELL AS MECHANICAL BREAKDOWN AND ACCIDENTS.

51. Production of heavy water in India has been
a slow process. India's heavy water plants
continue to face substantial problems resulting
from unreliable supply of power and other inputs
as well as mechanical breakdown and accidents.
In the 12 months from April 1981 to March 82,
India produced about 40 tons of heavy water.

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almost in half but it rebounded in
1983 to around 50 tons.

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PLANT	YEAR	TONS	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362
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95	95
96	96
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100	100

MANGAL, PUNJAB	9 TONS	9 TONS
TUTICORIN, TAMIL NADU	35 TONS	40 TONS
BARODA, GUJARAT	25 TONS	30 TONS
KOTA, RAJASTHAN	11 TONS	30 TONS
VALCHER BRIDGE	1 TON	2 TONS

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55. ROFA - THIS PLANT ADJOINS KAPU AND DEPENDS ON KAPU FOR ITS STEAM. ROFA USES AN INDEPENDENTLY DEVELOPED BITHERMAL HYDROGEN SULFIDE-WATER EXCHANGE PROCESS FOR PRE-ENRICHMENT AND A SODIUM DISTILLATION PROCESS FOR FINAL ENRICHMENT. THOUGH FIRST OPERATED IN JULY 1977, THE PLANT ONLY RAN FOR SIX MONTHS AT MINIMAL CAPACITY PRIOR TO A MAJOR ACCIDENT. THE PLANT WAS RECOMMISSIONED IN 1984 BUT DID NOT START OPERATING AGAIN UNTIL EARLY 85 AND THEN AT REDUCED PRESSURE. SINCE THEN, IT HAS BEEN CLOSD DOWN TWICE FOR MAINTENANCE DUE TO THE LEAK, ONE OF WHICH LED TO AN EMPLOYEE DEATH, AND SEVERAL TIMES FOR LACK OF STEAM. TO INSURE A MORE STEADY OPERATION, A STANDBY CAPTIVE STEAM GENERATION UNIT HAS BEEN PROPOSED. IF IT IS COMPLETED ON SCHEDULE AND OTHER PROBLEMS DO NOT OCCUR, THIS PLANT COULD BE PRODUCING AT PEAK CAPACITY IN 1989.

20. TUTICORIN - LINKED TO A FERTILIZER PLANT, TUTICORIN ALSO USES A VACUUM DISTILLATION PROCESS TO ENRICH THE LOW CONCENTRATION PRODUCT, ACHIEVED FROM AN AMMONIA-HYDROGEN EXCHANGE PROCESS, TO NUCLEAR GRADE. THIS YEAR WILL SEE THE REPLACEMENT OF THE PLANT'S CRACKER AND CONVERTER CATALYST. REPORTEDLY THE MAIN PROBLEM FOR THIS PLANT HAS BEEN INCONSISTENT POWER SUPPLY. UNPS I AND II ARE SUPPOSED TO CORRECT THAT DEFICIENCY AND, TO SOME EXTENT, HAVE DONE SO. TUTICORIN IS PROJECTED TO PRODUCE AT MAXIMUM CAPACITY BY 1988.

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57. BARODA - THOUGH COMMISSIONED IN 1977, THE PLANT DID NOT START PRODUCING HEAVY WATER UNTIL 1981. PRODUCTION DROPPED IN 1982 BUT SINCE THAT YEAR, HEAVY WATER PRODUCTION HAS INCREASED ANNUALLY AT THIS PLANT. THIS SHOULD CONTINUE THROUGH 1987 WHEN PEAK PERFORMANCE IS EXPECTED. MAJOR ACTIVITY SCHEDULED FOR 1986 INCLUDES REPAIRING THE EXISTING SYNTHETIC GAS COMPRESSOR, INSTALLING AN ADDITIONAL COMPRESSOR, AND AUGMENTING THE REFRIGERATION CAPACITY. BARODA IS ALSO AN AMMONIA-HYDROGEN EXCHANGE PLANT.

58. TALCHER - FROM MARCH UNTIL DECEMBER 1935, THIS PLANT WAS NOT OPERATING DUE TO POWER SHORTAGES AT THE LINKED FERTILIZER PLANT. AFTER FOUR MONTHS OF INTERMITTENT OPERATION, IN APRIL 1936 AN EXPLOSION OCCURRED IN THE PLANT'S CONTROL ROOM, THE LATEST IN A SERIES OF MISHAPS AND DISASTERS THAT HAVE CLOGGED THE PLANT SINCE 1972. THE PLANT WILL BE OUT OF OPERATION UNTIL NEAR THE END OF THIS YEAR. BESIDES NUMEROUS PROBLEMS (E.G., THE FAILURE OF CRITICAL EQUIPMENT, POOR ENRICHMENT), TALCHER APPARENTLY HAS A BASIC PROCESS FLAW--THE POTASSIUM AMIDE CATALYST WAS DEPOSITED EVERYWHERE AND CLOGGED THE TUBES AND REACTION TRAYS. THE PLANT THUS RAN FOR A WHILE AT ABOUT 20-25 PERCENT CAPACITY AFTER WHICH IT CAME TO A COMPLETE HALT DUE TO CLOGGING AND OTHER MINORLY CONSIDERING TROUBLES. TALCHER IS SUPPOSED TO PRODUCE HEAVY WATER BY THE BITHERMAL AMMONIA-HYDROGEN EXCHANGE PROCESS. IT WAS SUPPOSED TO BE FULLY OPERATIONAL BY SEPTEMBER 1985 BUT TO DATE, HAS PRODUCED LESS THAN TWO TONS OF HEAVY WATER. IT WAS SUPPOSED TO COST ABOUT \$100-120 MILLION BUT BY THE END OF THE DECADE WILL HAVE COST THREE TIMES THAT PRICE.

59. TALCHER - RESECTION AND REPAIRING WORK ARE IN PROGRESS. ALL IMPORTED MATERIAL

INDIGENOUS SUPPLIES ARE ON SITE. OCCASIONAL LABOR PROBLEMS AT THE FABRICATORS' SHOPS HAVE SLOWED WORK ON THE TOWER INTERNALS BUT DAE OFFICIALS STILL EXPECT THE PLANT TO BE FINISHED IN EARLY 1987 AS SCHEDULED. THIS PLANT WAS MODELED ON INDICONIN.

60. MANUGURU - MOST OF THE PLANT'S HEAVY EXCHANGE TOWERS HAVE BEEN ERECTED, MAJOR ITEMS HAVE BEEN ORDERED, AND CIVIL-MECHANICAL CONTRACTS HAVE BEEN AWARDED. THERE WERE DELAYS IN FABRICATION OF THE TOWER INTERNALS AND IN THE DELIVERY OF THE STEAM GENERATOR, BUT DAE OFFICIALS STILL EXPECT THE PLANT TO BE PRODUCING HEAVY WATER IN EARLY 1988. THIS WILL BE THE LAST GAS SULFIDE PLANT IN INDIA DUE TO CONCERN OVER THE ACCIDENT POTENTIAL INVOLVING THE RELEASE OF LARGE AMOUNTS OF HYDROGEN SULFIDE. THE PLANT WAS MODELED ON KOTA BUT UNLIKE THE REST OF INDIA'S HEAVY WATER PLANTS IS NOT TIED TO A FERTILIZER PLANT. A COPIED THERMAL POWER PLANT WILL PRODUCE ALL THE GASES NEEDED FOR HEAVY WATER PRODUCTION AT THE MANUGURU HEAVY WATER PLANT.

61. NAZIRA - CONSTRUCTION OF THIS PLANT HAS BEGUN. THE PLANT, MODELED ON THE TAL PLANT, IS SCHEDULED FOR COMPLETION BY 1988.

FAST BREEDER REACTORS

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62. LOADED WITH 22 INDIGENOUSLY DEVELOPED MIXED PLUTONIUM-URANIUM CARBIDE FUEL SUB-ASSEMBLIES, INDIA'S FIRST FAST BREEDER TEST REACTOR (FBTR), LOCATED AT KAPPAKAM, WENT CRITICAL IN OCTOBER, 1980, ONLY 60 DAYS BEHIND SCHEDULE. THE FUEL IS ABOUT 80 PERCENT INDIGENOUSLY BUILT. INDIA BECAME THE SEVENTH COUNTRY IN THE WORLD TO OPERATE A BREEDER. LOW POWER PHYSICAL EXPERIMENTS WERE CONDUCTED SUCCESSFULLY BEFORE THE REACTOR WAS SHUT DOWN TO PREPARE IT FOR ITS SECOND PHASE OF OPERATION. RECOMMISSIONING OF THE 15 MW REACTOR SHOULD OCCUR LATER THIS YEAR AND POWER OPERATION SHOULD BEGIN A FEW MONTHS LATER. DAE PLANS CALL FOR UPSCALING THIS REACTOR, EVENTUALLY, TO 500 MW.

63. KAPPAKAM WILL BE INDIA'S ONLY CARBIDE FUELED BREEDER. ALL FUTURE BREEDER REACTORS WILL USE METAL FUEL. DAE SCIENTISTS CONSIDER METAL FUEL TO BE THE WAVE OF THE FUTURE. THEY SAY THAT METAL FUELS ARE EASIER TO FABRICATE THAN CARBIDES, AND CAN BE REPROCESSED ON SITE. WASTE MATERIAL FROM METAL FUELED BREEDERS IS SOLID AND RELATIVELY EASY TO STORE, AND FAST BREEDER REACTORS USING METAL FUEL CAN PRODUCE MORE AND HIGHER GRADE PLUTONIUM THAN CAN NON-METAL REACTORS.

64. COMMERCIAL FAST BREEDER POWER REACTORS (FBPR) ARE STILL YEARS AWAY. IN 1981 DESIGNS WERE PREPARED FOR 300 MW FBPR. COST ESTIMATED AT THAT TIME WERE OVER 100 MILLION DOLLARS. THE FIRST COMMERCIAL FBPR IS A 300 MW POWER REACTOR, DESIGNED TO BE COMPLETED BEFORE THE YEAR 2000, AND IS SCHEDULED TO BE COMPLETED BY THAT YEAR. OF COURSE, THE BREEDER WILL NOT HAVE A 100 PERCENT PAYMENT SYSTEM. IN ORDER TO COVER THEIR FINANCIAL OBLIGATIONS, THEY WILL HAVE TO SELL THE PLUTONIUM PRODUCED INTO THE INTERNATIONAL

STOP THE REACTION. THE BREEDERS WILL NOT USE HEAVY WATER.

65. COMMISSIONING THE FBTR MARKS THE BEGINNING OF THE SECOND PHASE OF THE INDIAN NUCLEAR POWER PROGRAM. DURING THIS SECOND PHASE, PLANTS WILL FOR INITIAL BREEDING TO USE, AS FUEL, PLUTONIUM FROM THE PRESSURIZED HEAVY WATER REACTORS OBTAINED BY RE-PROCESSING THE PWR'S SPENT URANIUM OXIDE FUELS. INSIDE EACH BREEDER, A THORIUM OXIDE BLANKET WILL BE EXPOSED TO RADIATION YIELDING U-233 WHICH IS TO BE THE FUEL FOR THE SECOND GENERATION OF FBTR'S. IN THE THIRD PHASE OF THE PROGRAM, INDIA HAS VAST RESERVES OF THORIUM OXIDE AND DAE OFFICIALS EXPECT THAT THE THIRD PHASE WILL TAKE CARE OF INDIA'S ENERGY NEEDS UNTIL THE YEAR 2100.

66. TWO FACTORS, HOWEVER, ARE AFFECTING THE PACE OF BREEDING IN INDIA'S NUCLEAR FUTURE. FIRST, TESTS TO DATE SHOW THAT IT WOULD TAKE SOME 30 YEARS FOR A FIRST GENERATION BREEDER TO PRODUCE ENOUGH FUEL FOR A SECOND GENERATION BREEDER. THE THORIUM YIELDS ITS U-233 MUCH TOO SLOWLY FOR A VIABLE BREEDER PROGRAM.

67. SECONDLY, EXPERIMENTS IN SWITZERLAND SEEM TO INDICATE THAT A FUTURE FUSION-FISSIION HYBRID REACTOR MAY BE ABLE TO PRODUCE U-233 FROM THORIUM IN SIGNIFICANTLY LESS TIME. BARC SCIENTISTS, IN LAUSANNE SINCE 1984,

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HAVE BEEN WORKING WITH A SWISS ACCELERATOR AND KERALA BEACH THORIUM RODS TO PRODUCE U-233 BY INTENSIVE NEUTRON IRRADIATION. DR. M. SRINIVASAN, HEAD OF BARC'S NEUTRON PHYSICS DIVISION, AND DR. P. N. IYENGAR, BARC DIRECTOR, INDICATED THIS PAST AUGUST THAT THEY HOPE THE NEUTRON ACCELERATOR WILL BE REPLACED AT SOME FUTURE DATE BY A THERMONUCLEAR FUSION PLANT CAPABLE OF BREEDING EVEN LARGER QUANTITIES OF U-233 FROM THORIUM.

68. ACCORDING TO DR. SRINIVASAN, THE IDEA IS ULTIMATELY TO COMBINE A FUSION BREEDER WITH A CONVENTIONAL FISSION REACTOR INTO A FUSION-FISSION HYBRID REACTOR SYSTEM. IN THAT SYSTEM, U-233 WILL BE PRODUCED IN THE FUSION BREEDER AND THIS, ALONG WITH THORIUM, WOULD BE USED AS FUEL IN THE CONVENTIONAL REACTOR TO PRODUCE "NET ELECTRICITY" AFTER MEETING THE POWER DEMANDS OF THE PLANT. HE SAID THAT A SINGLE 750 MW FUSION PLANT SHOULD PRODUCE ENOUGH U-233 TO FUEL 40 RAJASTHAN TYPE REACTORS OPERATING ON A THORIUM U-233 (TH-U233) CYCLE.

69. DAE SCIENTISTS BELIEVE THAT IF THE HYBRID REACTOR CONCEPT BECOMES A REALITY, INDIA'S NUCLEAR TIMETABLE WOULD BE ADVANCED BY 20 YEARS. THE U-233 COULD BE BREED IMMEDIATELY ONCE FUSION NEUTRON SOURCES BECOME AVAILABLE. THIS WOULD ALSO MEAN THAT INDIA WOULD NOT HAVE TO BUILD FIRST THE HYBRID REACTOR WOULD BE A SERIOUS ALTERNATIVE TO PLUTONIUM-FILLED BREEDER. ADDITIONALLY, BAFE EXPERIMENTS HAVE DETERMINED THAT REACTORS BASED ON A TH-U233 CYCLE PRODUCE VERY LITTLE LONG LIVED WASTE WHEN COMPARED TO THOSE PRODUCED BY PLUTONIUM OR URANIUM REACTORS.

RESEARCH REACTORS

76. THE 100 MW HIGH FLUX RESEARCH REACTOR

DHRUVA, INDIGENOUSLY DESIGNED AND BUILT AT BARC, ATTAINED CRITICALITY IN AUGUST 1985. SHORTLY AFTERWARDS, WHILE OPERATING AT 10 MW, SEVERAL OF ITS FUEL RODS BECAME DETACHED. CONSEQUENTLY, THE REACTOR WAS RUN AT 25 MW AND ITS 129 FUEL RODS WERE DAMAGED BY OVER HEATING. DURING ITS OPERATION, RADIOACTIVE MATERIAL LEAKED INTO THE HEAVY WATER COOLANT. THESE PAST MONTHS HAVE WITNESSED DHRUVA'S PROJECT ENGINEERS ATTEMPTING, WITH SOME SUCCESS, TO STRAIN THE COOLANT USING A CENTRIFUGE.

JANSEN CHITRA V. PATIL STATED IN AUGUST TO THE LOK SABHA THAT DHRUVA'S FUEL CLAMPING MECHANISM HAD TO BE MODIFIED AS A RESULT OF WEAR ON THE ALUMINIUM CLADDING OF THE FUEL PINS. (THIS OCCURRED DURING INTENSE VIBRATION...)

72. (COMMENT). DHRUVA IS A RESEARCH REACTOR AND CAN BE USED AT LOW POWER BY DAE FOR RADIOISOTOPE RESEARCH.

DHRUVA MIGHT BECOME CRITICAL AGAIN

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THIS YEAR BUT THERE IS NO WAY TO PREDICT
WHEN DHRUVA WILL OPERATE AGAIN AT A LEVEL
APPROACHING FULL POWER. (END COMMENT.)

73. THE ASHOKA AND CIRUS REACTORS AT BARC
CONTINUE TO OPERATE RELATIVELY BETTER
WITH THE 40 MW CIRUS REACTOR COMPLETING
25 YEARS OF OPERATION. THE MAIN ACTIVITIES
AT THESE TWO REACTORS INCLUDE RADIATION
TESTING OF THORIUM OXIDE-PLUTONIUM OXIDE
FUEL ASSEMBLIES AND RADIOISOTOPE PRODUCTION.

74. ASHOKA HAS BEEN SHUT DOWN FOR SOME
TIME NOW BECAUSE OF A WATER LEAK IN ITS
THERMAL COLUMN. EARLIER THIS YEAR,
CIRUS WAS SHUT DOWN FOR EXTENDED MAINTENANCE.
IT IS NOW OPERATING AT HALF POWER.

75. THE POOR OPERATION OF ASHOKA, CIRUS,
AND DHRUVA HAS LED TO A SHORTAGE OF RADIOISOTOPES
AND RADIOPHARMACEUTICALS IN INDIA'S HOSPITALS.
INDIAN RADIOISOTOPE RESEARCHERS HAVE BEEN FORCIBLY
AND CANCELED AND BARC IS NOW IMPORTING NUCLEAR
INDIUMS FROM ENGLAND. THESE ISOTOPES ARE
EXPECTED TO BE NEEDED AT LEAST THROUGH 1986.

REPROCESSING

76. THE PLUTONIUM PLANT AT TROPIC CONTINUED
TO REPROCESS FUEL DISCHARGED FROM THE CIRUS REACTOR.
THE POWER REACTOR FUEL REPROCESSING PLANT (PREPARE)
AT TARAPUR COMPLETED REPROCESSING SOME SPENT FUEL
BUNDLES FROM RAPP. UNGUARDED FUEL FROM THE
MAPS 1 REACTOR HAS ALSO BEEN REPROCESSED AT
PREPARE TO EXTRACT PLUTONIUM. HOWEVER, TARAPUR
SPENT FUEL IS NOT BEING REPROCESSED, ONLY STORED.
THIS PLANT IS NOW SHUT DOWN FOR EXTENDED MAINTENANCE.

76. AT THE RAIPUR REPROCESSING PLANT,
BUILDING CONSTRUCTION, MATERIALS PROCUREMENT,
AND PROCESS AND COMPONENT VESSEL FABRICATION
ARE ALL PROCEEDING SATISFACTORILY, ACCORDING
TO DAE. DAE IS ALSO CONSIDERING A PROPOSAL TO
ESTABLISH AN ENGINEERING FACILITY AT BARC FOR
PROCESSING IRRADIATED THORIUM FROM THE CIRUS
AND DHRUVA REACTORS TO SEPARATE THE U-235.

B1, A5

75. INDIA'S FIRST U-235 FUELED EXPERIMENTAL
REACTOR, DHRUVA, WHICH HAS BEEN IN
OPERATION SINCE 1970, HAS BEEN
USED TO CHECK THE FEASIBILITY OF VARIOUS
CONTROL AND SAFETY SYSTEMS. THE 30 KW REACTOR
CANNOT OPERATE FOR LONGER PERIODS DUE TO
BE FILLED BY THE 1.5 MW THERMAL REACTOR
AT BARC. THE REACTOR MAY BE COMPLETED BY THE END OF THE YEAR.

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C O N F I D E N T I A L SECTION 17 OF 22 NEW DELHI 22414

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E.O. 12356: DECL:OATP

TAGS: INR, TPGY, WPRP, IN

SUBJ: INDIA'S NUCLEAR ENERGY PROGRAM

RADIOACTIVE WASTE MANAGEMENT

79. DAE ESTIMATES THAT INDIA'S PRIMARY
SOLID WASTES AND LOW-LEVEL CONCENTRATES
AMOUNT TO MORE THAN 5,000 CUBIC METERS.
IN ADDITION, 800 CUBIC METERS OF INTERMEDIATE-LEVEL
WASTES AND 450 CUBIC METERS OF HIGH-LEVEL WASTES
HAVE BEEN PRODUCED. BY THE TURN OF THE
CENTURY, AN ESTIMATED ALMOST 112 THOUSANT CUBIC

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METERS OF PRIMARY SOLID WASTES AND 77,000 CUBIC

METERS OF LOW-LEVEL WASTES WILL HAVE BEEN

PRODUCED. A FURTHER 20,000 CUBIC METERS OF

INTERMEDIATE-LEVEL WASTES AND ABOUT 8,000

CUBIC METERS OF HIGH-LEVEL WASTES WILL HAVE

THEN BEEN GENERATED.

82. CONSTRUCTION OF THE SOLID STORAGE

SURVEILLANCE FACILITY AT TARAPUR IS BEING

COMPLETED AFTER EIGHT YEARS AND AT A COST

OF FOLS 160 MILLION. THIS FACILITY, WHICH
SHOULD BE OPERATIONAL BEFORE THE END OF THE
YEAR, WILL STORE FOR UP TO 25 YEARS SOLIDIFIED
HIGH-LEVEL RADIOACTIVE WASTE PACKAGES
PRODUCED IN THE WASTE IMMOBILIZATION PLANT,
ALSO AT TARAPUR. TR. N.S. SUNDER RAJAN.

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HEAD OF BARC'S WASTE MANAGEMENT DIVISION,
SAID RECENTLY THAT THE TARAPUR PLANT TAKES
CARE OF 120 LITERS PER HOUR OF INTERMEDIATE
LEVEL WASTES. MORE THAN 250,000 LITERS HAVE
BEEN NEUTRALIZED SO FAR, HE INDICATED.
P1. CONSTRUCTION OF THE NAPP WASTE MANAGEMENT
PLANT IS AT AN ADVANCED STAGE. THIS PLANT
SHOULD BE OPERATIONAL IN 1988. DESIGN WORK
HAS BEGUN ON THE WASTE IMMOBILIZATION
PLANT AT TROMBAY. SCHEDULED FOR COMPLETION
IN 4 YEARS. ADDITIONALLY, AN ALPHA WASTE
MANAGEMENT FACILITY FOR FAST BREEDER WASTES
HAS BEEN PROPOSED FOR KALPAKKAM. IT IS
EXPECTED TO BE OPERATIONAL BY 1993.
LOW LEVEL RADIOACTIVE WASTES WILL CONTINUE
TO BE DEPOSITED IN REINFORCED CURRENT CONCRETE

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TRENCHES LOCATED NEAR TAPS. PAPS, MAPS,
AND AT TROMBAY.

S2. INDIAN NUCLEAR SCIENTISTS ARE ALSO
STUDYING THE FEASIBILITY OF DISPOSING OF
RADIOACTIVE WASTES UNDERGROUND. AN
EXPERIMENTAL RESEARCH STATION HAS BEEN SET
UP IN AN UNUSED PORTION OF THE KOLAR GOLD
MINES, NEAR BANGALORE, TO EXAMINE THE
GEOLOGICAL FORMATIONS.

NUCLEAR RESEARCH

S3. PHARMA ATOMIC RESEARCH CENTER (BARC),
BOMBAY -- THE MAJOR OBJECTIVE OF INDIA'S
PREEMINENT NUCLEAR CENTER IS TO PROVIDE
RESEARCH AND DEVELOPMENT SUPPORT NEEDED TO

SUSTAIN INDIA'S NUCLEAR POWER PROGRAM WITH
RESPECT TO CONCEPTS, DESIGNS, MATERIALS,
RELIABILITY, AND SAFETY. RESEARCH IS
CONDUCTED IN THE FOLLOWING BROAD AREAS:
NUCLEAR REACTORS, RADIOISOTOPES, NUCLEAR FUEL
CYCLE, METALLURGY, HEAVY WATER, RADIOLOGICAL
SAFETY, BASIC RESEARCH, MAGNETOHYDRODYNAMICS,
LASERS, FUSION ACCELERATORS, ROBOTICS, AND
ELECTRONIC INSTRUMENTATION.

S4. INDIRA GANDHI CENTER FOR ATOMIC RESEARCH
(IGCAR), KALPAKKAM -- FORMERLY
KNOWN AS THE REACTOR RESEARCH CENTER (RRC), THE
CENTER IS PRINCIPALLY CONCERNED WITH FAST
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BREEDER REACTOR DEVELOPMENT, FUEL RE-PROCESSING, AND RADIATION SAFETY. INCAPI'S WORK ON BREEDER REACTORS INCLUDES PREPARING DESIGN SPECIFICATIONS, ENGINEERING DEVELOPMENT OF FBTR COMPONENTS, AND METALLURGICAL EVALUATION OF CANDIDATE MATERIALS. ONE LABORATORY WORKS ON DEVELOPING FAST REACTOR FUEL REPROCESSING TECHNOLOGIES AND ON DESIGNING THE FAST REACTOR PART OF THE KALPAKKAM REPROCESSING PLANT.

25. CENTER FOR ADVANCED TECHNOLOGY (CAT), INDORE-- A CENTER FOR RESEARCH AND DEVELOPMENT IN THE AREA OF LASERS, ACCELERATORS, AND FUSION, CAT WILL INITIALLY WORK TO DEVELOP A COPPER VAPOR LASER AND A TRANSVERSE FLOW HIGH POWER CARBON DIOXIDE LASER. ABOUT 20 SCIENTISTS AND 20 TECHNICIANS HAVE OCCUPIED THE 3225 SQUARE METERS OF LABORATORY SPACE COMPLETED SO FAR; ONE HUNDRED ARE SCHEDULED TO BE WORKING HERE BY THE END OF THE YEAR AS MORE ACTIVITIES ARE SHIFTED TO CAT FROM BARC. A HOUSING COMPLEX HAS BEEN COMPLETED AND TWO WORKSHOPS ARE UNDER CONSTRUCTION. PLANS ARE ALSO UNDERWAY TO BUILD A PROTON SYNCHROTRON AND A HIGH ENERGY ELECTRON ACCELERATOR AT CAT.

26. THREE OTHER CENTERS ROUNDED OUT DURING NUCLEAR RESEARCH FACILITIES. THE TATA INSTITUTE OF FUNDAMENTAL RESEARCH, BOMBAY, CONDUCTS THEORETICAL RESEARCH INTO VARIOUS FIELDS OF MATHEMATICS, NUMERICAL METHODS, AND PHYSICS, INCLUDING NUCLEAR AND ATOMIC PHYSICS. THE URBAN INSTITUTE OF NUCLEAR PHYSICS, CALCUTTA, CONDUCTS RESEARCH IN NUCLEAR PHYSICS AND OTHER FIELDS. THE INSTITUTE OF PHYSICS, BOMBAY, CONDUCTS RESEARCH IN NUCLEAR PHYSICS AND OTHER FIELDS.

27. THE ATOMIC ENERGY REGULATORY BOARD (AERB) WAS CONSTITUTED BY THE GOVT OF INDIA INDEPENDENT SAFETY REGULATORY BODY TO ENSURE THE SAFETY OF ALL NUCLEAR INSTALLATIONS. THE AERB CAN ORDER CLOSURE OR STOPPAGE OF A UNIT IF IT IS POSING RADIATION HAZARDS. THE BOARD WAS ESTABLISHED IN LIGHT OF NUMEROUS REPORTS OF RADIATION LEAKS AND OTHER PROBLEMS.

FOR EXAMPLE, IN AUGUST 1986, MINISTER SHIVRAJ V. PATIL TOLD THE LOK SABHA THAT THERE HAD BEEN NO INCIDENTS INVOLVING RADIATION LEAKAGE IN ANY INDIAN ATOMIC POWER PLANT WHICH HAD CAUSED PHYSICAL DAMAGE TO ANY WORKERS OF THE PLANT. YET IN MAY 1983, THE AERB RELEASED SOME RECORDS OF THE TARAPUR RADIATION LEAKS ONLY ON THE CONDITION THAT NO DAMAGE COULD BE PROVEN TO ANY OF THE DAE BY THE AFFECTED WORKERS ON THE BASIS OF THE RELEASED INFORMATION. THE REPORT ADMITTED THAT 328 WORKERS HAD BEEN EXPOSED TO RADIATION EXCEEDING, SOME BY MORE THAN 4 TIMES, INTERNATIONALLY-ACCEPTED NORMS.

28. DURING THE 1980'S, A NUMBER OF DIFFERENT SAFETY PROBLEMS IN INDIA'S NUCLEAR PROGRAM SURFACED IN THE PRESS AND IN OTHER REPORTS. A PARTIAL LISTING FOLLOWS:

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IN INDIA ARE VERY REMOTE DUE TO THEIR
DESIGNED AND ENGINEERED SAFETY PRECAUTIONS.
THEIR "DEFENSE IN DEPTH", AND BECAUSE THE
STATIONS ARE RUN BY TRAINED AND EXPERIENCED
ENGINEERS AND SCIENTISTS.

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P 150943Z SEP 86
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1980

MAJOR LEAK IN PRIMARY COOLANT PIPE AT TAPS.
MAJOR LEAK OF CONTAMINATED WATER AT TAPS.

1981

RADIATION LEAK AT RAPS.

1982

COMBUSTIBLE NUCLEAR FUEL SCRAP FOUND BY
CHILDREN AT THE NUCLEAR FUEL COMPLEX, HYDERABAD

1983

EXCESSIVELY HIGH RADIATION LEVELS AT TAPS
AND RAPS ADMITTED BY DAE, NEARLY THE HIGHEST
EVER RECORDED IN ANY OF THE WORLD'S NUCLEAR
POWER STATIONS.

1984

ENGINEER DIES FROM H2S GAS LEAK AT THE KOTA
HEAVY WATER PLANT.

1985

FIRE IN REACTOR BUILDING AT RAPS II.

1986

EXPLOSION AND FIRE AT TALCHER HEAVY WATER PLANT.
FUEL LEAK CONTAMINATED HEAVY WATER AT RAPS.

89. IN AN AUGUST PRESS INTERVIEW,
INDIAN AERB CHAIRMAN DR. JAMUN KUMAR DE
EXPLAINED THAT THE AERB'S MANDATE IS TO
OVERSEE THE SAFETY ASPECTS OF ALL FACETS
OF INDIA'S NUCLEAR POWER STATIONS--SITE
SELECTION, DESIGN, CONSTRUCTION, COMMISSIONING,
OPERATION, ETC. HE SAID THAT THE CHANCES OF
A MAJOR ACCIDENT IN ANY NUCLEAR POWER REACTOR

WE HAVE REPORTED SIMILAR POST-CHERNOBYL
INTERVIEWS AND ASSURANCES WHICH HAVE BEEN
GIVEN IN THE PRESS BY DR. RAJA RAMANNA AND
DR. M.R. SRINIVASAN AND IN PARLIAMENT BY
RAJIV GANDHI AND SHIVRAJ V. PATIL.

90. SOME OF THE SAFETY ASPECTS OF THE INDIAN
NUCLEAR PROGRAM INCLUDE:

- A DOUBLE CONTAINMENT SYSTEM FOR ALL FIRST
GENERATION REACTORS BEGINNING WITH RAPS;
- QUALIFIED NUCLEAR ENGINEERS AT EVERY REACTOR
ON EVERY SHIFT;
- SPREADING OVEREXPOSURE TO RADIATION AMONG
PLANT PERSONNEL SO THAT NO SINGLE WORKER
EXCEEDS THE MAXIMUM ALLOWABLE LIFETIME DOSE
(WHICH COULD BE ONE OF THE REASONS FOR
INCREASINGLY GLOWING REPORTS OF INDIA'S
NUCLEAR POWER PROGRAM);
- PLANT OPERATOR EMERGENCY PLANS AND

BIAS

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P 150948Z SEP 86
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PERIODIC DRILLS;

-- AN EMERGENCY ACTION PLAN FOR THE AREA
SURROUNDING EACH PLANT;

-- ONE GENERATOR LOCATED NEAR EACH REACTOR
TO INSURE EACH REACTOR'S SAFETY SYSTEM IS
SUPPLIED WITH ENERGY (BEGINNING WITH MAPS,
A THIRD GENERATOR IS BEING INSTALLED WHICH
CAN OPERATE WITH EACH REACTOR);

-- A ONE MILE RADIUS EXCLUSION ZONE AROUND
EACH REACTOR WITH AN ADDITIONAL THREE MILE
RADIUS ZONE WHERE NO POPULATION GROWTH IS
PERMITTED;

-- RADIATION TESTS ON SOIL, VEGETATION, FISH,
MILK, ETC. CONDUCTED IN THE AREAS AROUND
THE POWER STATIONS;

-- A QUANTITY OF IODINE AT EACH PLANT;

-- TRANSPORTATION OF SPENT FUEL BY RAIL IN
SEALED CONTAINERS TO THE TARAPUR PROCESSING PLANT;

-- COMPUTER CONTROLLED REACTOR OPERATING SYSTEMS
(ALTHOUGH APPARENTLY WITHOUT SAFETY CODES, WRITTEN IN
THE PROGRAMS, WHICH SENSE CRITICAL SITUATIONS
AND INITIATE CORRECTIVE ACTION).

91. ONE SAFETY ISSUE WHICH CONTINUES TO
RECEIVE PLAY IN PARLIAMENT AND THE PRESS IS
THE SAFETY OF NUCLEAR PLANTS SITED IN
EARTHQUAKE ZONES. MUCH OF THIS TYPE
QUESTIONING DEALS WITH NARORA WHICH, IN
ADDITION TO BEING IN AN EARTHQUAKE ZONE,
IS SITUATED NEXT TO THE GANGES RIVER.
NARORA DETRACTORS SAY THE SITE HAS NO FIRM
FOUNDATION--THE WATER TABLE IS LESS THAN
15 METERS BELOW GROUND AND THERE IS NO
ROCK EVEN TO A DEPTH OF 300 METERS.
THERE IS SOME QUESTION AS TO WHETHER ITS
SITE WAS SELECTED BEFORE OR AFTER SEISMIC

STUDIES WERE DONE. SOME PEOPLE ARE AFRAID
THAT AN EARTHQUAKE WILL CAUSE THE PLANT TO
BREAK OPEN AND SPEW RADIOACTIVE MATERIAL INTO
THE RIVER (THUS MAKING IT EVEN MORE POLLUTED
THAN IT IS NOW.)

92. THE TYPICAL INDIAN OFFICIAL RESPONSE
CONTAINS THE FOLLOWING ELEMENTS. FIRST,
TWO-THIRDS OF THE INDIAN SUBCONTINENT IS IN
THE SEISMIC ZONE AND THE ENTIRE INDO-GANGETIC
PLANE IS SEISMICALLY ACTIVE. IF DAE WAS TO
AVOID SEISMIC ZONES, REACTORS COULD ONLY BE
LOCATED IN THE DECCAN PLATEAU IN THE SOUTH.
THIS WOULD FORCE THE ENTIRE OF NORTH INDIA
TO RELY ON HYDROELECTRIC AND COAL FOR
ELECTRICITY, SOURCES WHICH ARE NOT EVENLY
DISBURSED IN THE REGION AND WHICH DO NOT
MEET THE DEMAND FOR COMMERCIAL POWER NOW, MUCH
LESS IN THE FUTURE. SECONDLY, INDIA'S NUCLEAR
PLANTS HAVE BEEN DESIGNED TO BE SAFE IN SEISMIC
ZONES. THEY WILL COME TO A SAFE SHUTDOWN
CONDITION AT 0.3G HORIZONTAL GROUND ACCELERATION
AND CAN KEEP OPERATING AT 0.15G. THE NARORA PLANTS
HAVE BEEN DESIGNED TO WITHSTAND AN EARTHQUAKE OF
6.7 ON THE RICHTER SCALE. THIRDLY, THE CASE OF
JAPAN, A VERY EARTHQUAKE-PRONE COUNTRY WITH A
RAPIDLY INCREASING NUMBER OF NUCLEAR PLANTS, IS
USED TO SHOW THAT NUCLEAR PLANTS IN EARTHQUAKE
PRONE AREAS CAN BE SAFE.

INDO-US NUCLEAR COOPERATION

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96. BARC HAS BEEN CONDUCTING SIGNIFICANT RESEARCH INTO NUCLEAR FUELS IN ORDER TO, BROADLY SPEAKING, MAXIMIZE THE USE OF INDIAN THORIUM, FIND WAYS TO USE THE ACCUMULATING, SAFEGUARDED PLUTONIUM FROM RAPS, BECOME EVEN MORE SELF-RELIANT, AND KEEP OUT FROM UNDER IAEA SAFEGUARDS.

THIS RESEARCH MAY ALSO IMPACT ON INDIA'S BREEDER PROGRAM. BY THE END OF THE DECADE, WE SHOULD BE BETTER ABLE TO TELL WHETHER THESE EXPERIMENTS WILL BENEFIT INDIA'S NUCLEAR PROGRAM AS MUCH AS DAE SCIENTISTS NOW HOPE.

98. WE PROJECT INDIA'S FUTURE HEAVY WATER PRODUCTION TO INCREASE AROUND 30 TONS

94. IN ADDITION, THERE ARE SEVERAL ONGOING INDO-US COLLABORATIVE PROJECTS IN BASIC NUCLEAR PHYSICS TOTALING ALMOST ONE HALF MILLION DOLLARS IN US FUNDING. DR. RAJA RAMANNA HAS EXPRESSED HOPE THAT INDO-US NUCLEAR RESEARCH CAN BE CARRIED OUT AT CAT-INDORE SINCE THAT FACILITY WILL BE SEPARATED FROM INDIA'S NUCLEAR ENERGY FACILITIES.

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P 150940Z SEP 86
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THE GOI AND THE DAE ARE FULLY COMMITTED TO SUBSTANTIALLY INCREASING INDIA'S NUCLEAR POWER CAPACITY AND JUST AS FULLY COMMITTED TO DOING SO INDIGENOUSLY. THOUGH PROBLEMS WILL CONTINUE TO HINDER DAE ACCOMPLISHMENT OF THESE GOALS, GOOD PROGRESS HAS BEEN MADE, THE PROBLEMS ARE BEING ADDRESSED, AND THE FUTURE HOLDS PROMISE OF SUBSTANTIAL ACHIEVEMENT. END COMMENT.
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ANNUALLY FOR THE NEXT FEW YEARS. THIS PRODUCTION SHOULD ENABLE DAE TO BRING KAPP AND KAPP ON LINE AS SCHEDULED (1986-1992) WITHOUT RESORTING TO HEAVY WATER IMPORTS OR TO ILLEGAL DIVERSION OF SAFEGUARDED HEAVY WATER.

99. WE BELIEVE, NEVERTHELESS, THAT RAMANNA IS BEING OVERLY OPTIMISTIC WHEN HE PREDICTS THAT BY THE YEAR 2000 INDIA WILL HAVE 10,000 MW OF INSTALLED NUCLEAR POWER CAPACITY. WE DO NOT DOUBT THOUGH THAT BY THAT TIME INDIA WILL HAVE 10,000 MW UNDER CONSTRUCTION. INDIA'S SCIENTIFIC KNOWHOW AND DESIGN EXPERTISE ARE AMONG THE WORLD'S BEST. AS INDIA'S INDUSTRIALIZATION CONTINUES, PLANT CONSTRUCTION TIME SHOULD MARKEDLY DECREASE AND THE QUALITY OF INDIAN-MADE PARTS SHOULD IMPROVE AS WELL.

100. SINCE THE FIGURE OF 10,000 MW WAS SAID TO HAVE BEEN SELECTED AS THE MINIMUM LEVEL NECESSARY TO FUEL A SELF-SUSTAINING BREEDER CYCLE DURING THE SECOND PHASE OF INDIA'S NUCLEAR POWER PROGRAM, IF NUCLEAR FUEL RESEARCH ELIMINATES THE NEED FOR BREEDERS, THAT GOAL AND THE PEACOCKS FOR REACHING IT BECOME LESS IMPORTANT. TO THE EXTENT THAT FUSION-FISSION HYBRID REACTOR RESEARCH APPEARS MORE PROMISING, EMPHASIS ON ATTAINING 10,000 MW BY THE YEAR 2000 WILL DECREASE; MORE EMPHASIS IS LIKELY TO BE PLACED ON BUILDING AND OPERATING THE PLANTS THAT TIME AND CIRCUMSTANCES PERMIT RATHER THAN ON GOAL ATTAINMENT.

101. INDIA'S PROGRESS IN ITS NUCLEAR PROGRAM WILL GO HAND-IN-HAND WITH ITS INDUSTRIAL DEVELOPMENT. THEIR NUCLEAR PROGRAM IS NOT SUFFERING FROM A LACK OF KNOWHOW OR FROM A LACK OF TECHNICALLY SOPHISTICATED SCIENTISTS AND ENGINEERS BUT MORE FROM POOR PRACTICES OF PRODUCTION AND MAINTENANCE. NEVERTHELESS, THERE SHOULD BE NO DOUBT THAT

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